

WHAT IS CLAIMED IS:

1      1. A wafer transfer machine for transferring wafers from either of a first wafer  
2      cassette and a second wafer cassette into the other, comprising:  
3              (a) a support structure having a support surface for supporting the first and  
4      second wafer cassettes;  
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6              (b) a first registration feature located in fixed relationship to the support  
7      surface for engaging a registration feature of the first wafer cassette, and a second registration  
8      feature located in fixed relationship to the support surface for engaging a registration feature of  
9      the second wafer cassette;  
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11              (c) a carriage mechanism supported by and movable in opposite directions  
12      along a track mechanism that is supported in fixed relationship to the support structure; and  
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14              (d) a first wafer pushing member rigidly connected to the carriage mechanism  
15      for engaging edges of semiconductor wafers in the first wafer cassette and pushing them out of  
16      the first wafer cassette into the second wafer cassette, and a second wafer pushing member  
      rigidly connected to the carriage mechanism for engaging edges of semiconductor wafers in the  
      second wafer cassette and pushing them out of the second wafer cassette into the first wafer  
      cassette.

1           2.     A method of transferring wafers from either of a first wafer cassette and a second  
2           wafer cassette into the other wafer cassette, comprising:

3           4           5           6           (a)     supporting the first wafer cassette adjacent to and in alignment with the  
second wafer cassette such that wafer slots of the first wafer cassette are precisely aligned with  
wafer slots of the second wafer cassette, one of the first and second wafer cassettes being loaded  
with semiconductor wafers and the other of the first and second wafer cassettes being empty;

7           8           9           10          11          12          13          14          (b)     supporting a first wafer pushing member and a second wafer pushing  
member by a mechanism for selectively moving the first wafer pushing member into and out of  
the first wafer cassette and also selectively moving the second wafer pushing member into and out of  
the second wafer cassette; and

15          16          17          18          19          20          21          22          23          24          25          (c)     operating a mechanism to move the one of the first wafer pushing member  
and the second wafer pushing member which is closest to the semiconductor wafers in the loaded  
wafer cassette to engage the edges of the semiconductor wafers and push them out of the loaded  
wafer cassette into the empty wafer cassette.

1           2           3           3.     A wafer transfer machine for transferring wafers from either of a first wafer  
cassette and a second wafer cassette having incompatible registration features into the other,  
comprising:

- (a) a support plate having a top surface for supporting the first and second wafer cassettes;
- (b) a first registration boss attached to the top surface for extending upward into and engaging a registration feature of the first wafer cassette, and a second registration boss attached to the top surface for extending upward into and engaging a registration feature of the second wafer cassette;
- (c) a carriage supported by and movable in opposite directions along a track mechanism that is attached in fixed relationship to the support plate; and
- (d) a first wafer pushing member rigidly connected to the carriage for engaging edges of semiconductor wafers in the first wafer cassette and pushing them out of the first wafer cassette into the second wafer cassette, and a second wafer pushing member rigidly connected to the carriage for engaging edges of semiconductor wafers in the second wafer cassette and pushing them out of the second wafer cassette into the first wafer cassette.

4. The wafer transfer machine of claim 3 including a handle attached to the carriage manually moving carriage along the track mechanism to cause one of the first and second pushing members to push wafers from one of the first and second wafer cassettes into the

1           5. The wafer transfer machine of claim 3 wherein the support plate, carriage, and the  
2           first and second wafer pushing members are composed of plastic material.

1           6. The wafer transfer machine of claim 3 wherein the track mechanism includes  
2           cylindrical first and second slide rods which are parallel to the top surface of the support plate  
and are parallel to each other.

1           7. The wafer transfer machine of claim 6 wherein the carriage includes parallel first  
2           and second cylindrical holes through which the first and second slide rods, respectively, extend  
3           to allow bidirectional sliding of the carriage along the first and second slide rods.

1           8. The wafer transfer machine of claim 3 wherein the track mechanism and carriage  
2           are underneath the support plate, and wherein the support plate includes a first elongated slot  
3           through which the first wafer pushing member extends upward to a level of wafers supported in  
4           the first wafer cassette, and wherein the support plate includes a second elongated slot through

5 which the first wafer pushing member extends upward to a level of wafers supported in the  
6 second wafer cassette.

9. The wafer transfer machine of claim 8 wherein the first and second wafer pushing members are supported by opposite ends of a push-pull rod extending through the third cylindrical hole of the carriage and rigidly attached to the carriage.

10. The wafer transfer machine of claim 9 wherein the first wafer pushing member includes a first vertical section having a lower end rigidly attached to a first end section of the pull rod, a first horizontal section having a first end attached to and integral with an upper end of the first vertical section and also having a second end attached to and integral with a lower end of a second vertical section, and wherein the second wafer pushing member includes a third vertical section having a lower end rigidly attached to a second end section of the push-pull rod, and horizontal section having a first end attached to and integral with an upper end of the second vertical section and also having a second end attached to and integral with a lower end of a fourth vertical section.

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1 11. The wafer transfer machine of claim 4 including an alignment knob attached to an  
2 edge of the support plate in a location aligned with the handle when the carriage is located at a  
3 center position which allows placing and removal of the first and second wafer cassettes in  
4 engagement with the first and second registration bosses, respectively, and allows removal of the  
5 first and second wafer cassettes from the support plate.

12. The wafer transfer machine of claim 8 including first, second, third, and fourth  
legs supporting first, second, third, and fourth corner portions of the support plate, respectively,  
wherein opposite ends of the first slide rod engage and are supported by the first and fourth legs,  
respectively, and wherein opposite ends of the second slide rod engage and are supported by the  
second and third legs, respectively.

13. A wafer transfer machine for transferring wafers from either of a first wafer  
cassette and a second wafer cassette having incompatible registration features into the other,  
comprising:

- (a) support means for supporting the first and second wafer cassette;
- (b) registration means attached to the support means for extending upward into and engaging registration features of the first wafer cassette and the second wafer cassette;
- (c) a track mechanism and means for supporting the track mechanism in fixed relationship to the support plate;
- (d) carriage means for movement in opposite directions along the track mechanism; and
- (e) first wafer pushing means supported by the carriage means for engaging edges of semiconductor wafers in the first wafer cassette and pushing them out of the first wafer cassette into the second wafer cassette in response to movement of the carriage means along the track mechanism in a first direction, and a second wafer pushing means supported by the carriage means for engaging edges of semiconductor wafers in the second wafer cassette and pushing them out of the second wafer cassette into the first wafer cassette in response to movement of the carriage means along the track mechanism in a second direction.

1           14. A method of transferring wafers from either of a first wafer cassette and a second  
2           wafer cassette having incompatible registration features into the other wafer cassette, comprising:

3           (a) supporting the first wafer cassette on a support plate in registration with a  
4           first registration boss extending into and engaging a registration feature of the first wafer  
5           cassette, and supporting the second wafer cassette on the support plate in registration with a  
6           second registration boss extending into and engaging a registration feature of the second wafer  
7           cassette, one of the first and second wafer cassettes being loaded with semiconductor wafers and  
8           the other of the first and second wafer cassettes being empty;

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9           (b) supporting a first wafer pushing member and a second wafer pushing  
10           member by means of a carriage supported by and movable in opposite directions along a track  
11           mechanism; and

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12           (c) moving the carriage in a direction that causes one of the first wafer  
13           pushing member and the second wafer pushing member which is closest to the semiconductor  
14           wafers in the loaded wafer cassette to engage the edges of the semiconductor wafers and push  
15           them out of the loaded wafer cassette into the empty wafer cassette.

1           15. The method of claim 14 further including moving the carriage to a centered  
2           position that allows removal of the first and second wafer cassettes from the support plate.

1           16. A machine for transferring wafers from either of a first wafer cassette and a  
2           second wafer cassette into the other wafer cassette, comprising:

8           (a) means for supporting the first wafer cassette adjacent to and in alignment  
9           with the second wafer cassette such that wafer slots of the first wafer cassette are precisely  
10           aligned with wafer slots of the second wafer cassette, one of the first and second wafer cassettes  
11           being loaded with semiconductor wafers and the other of the first and second wafer cassettes  
12           being empty;

13           (b) means for supporting a first wafer pushing member and a second wafer  
14           pushing member by a mechanism for selectively moving the first wafer pushing member into and  
15           out of the first wafer cassette and also selectively moving the second wafer pushing member into  
16           and out of the second wafer cassette; and

17           (c) means for moving the one of the first wafer pushing member and the  
18           second wafer pushing member which is closest to the semiconductor wafers in the loaded wafer  
19           cassette to engage the edges of the semiconductor wafers and push them out of the loaded wafer  
20           cassette into the empty wafer cassette.